Remarks

The present Preliminary Amendment is submitted to provide the requisite cross-reference to the parent application on page 1 of the specification and to amend the specification in a manner similar to that in the parent application Serial No. 09/453,216, and thereby to place the case in better condition for examination.

Further, the following remarks concerning present claims 1 and 5 are in response to the rejection of claims 1 and 10, respectively, in the Office Action dated January 15, 2004 for application serial number 09/453,216 of which the present application is a continuation.

Claim 1 is patentable over Masuyama (US 6,397,347) in view of Chen (US 5,968,182), since claim 1 recites a disk array device having, in part, a control part operable to issue second read requests to read data blocks and redundant data from m disk drives in response to a first read request sent thereto, detect a disk drive, from among the m disk drives, from which reading of either one of the data blocks or the redundant data is no longer necessary, and issue a read termination command to terminate reading of the one of the data blocks or the redundant data by the detected disk drive, wherein the detected disk drive is enabled to commence reading of any subsequent data block or redundant data without being disconnected from the disk array device. The combination of Masuyama and Chen fails to disclose or suggest a control part as recited in claim 1.

Masuyama discloses a disk array apparatus having a disk array controller 21, four disk controllers 31-1 - 31-4, and four disk units 41-1 - 41-4 having a RAID-3 configuration. The disk array controller 21 has a detector/memory section 211 and a temporary degenerate mode disk array controller 212. The temporary degenerate mode disk array controller 212 has a disconnection managing section 212a, a retry section 212b, and a reentry section 212c. When a writing instruction is received by the controller 21, the controller 21 distributes write data and redundant data to the four disk controllers 31-1 - 31-4 to be stored in the four disk units 41-1 - 41-4, respectively. Further, when a reading instruction is received by the controller 21, the controller 21 instructs the four disk controllers 31-1 - 31-4 to read the stored data from the four disk units 41-1 - 41-4, respectively. The controller 21 then assembles the stored data and delivers the assembled data.

If, during a reading operation, an abnormality or error is detected in one of the four disk units 41-1 - 41-4, the detector/memory section 211 memorizes the faulty unit information representative

of the particular disk unit and delivers the faulty unit information to the disconnection managing section 212a. The disconnection managing section 212a then temporarily disconnects the faulty disk unit from the disk array apparatus and the controller 21 continues the reading operation with the remaining disks. Further, the retry section 212b is supplied with the faulty unit information from the detector/memory section 211 and executes a number of operations in parallel with the reading operation of the controller 21. These operations include: (1) executing the read operation in which the error occurred again to confirm whether a similar abnormality occurs; (2) if the similar abnormality occurs, rewriting data stored at a position where the abnormality has occurred to recover a state where the stored data can be normally read; and (3) if the similar abnormality occurs, inhibiting the use of the faulty position. (See column 4, line 10 - column 5, line 10; column 5, line 47 - column 7, line 18; and Figures 1 and 2).

Based on the above discussion of Masuyama, it is apparent that when executing a reading operation, the controller 21 reads data from all of the four disk units 41-1 - 41-4, unless an error or abnormality is detected on one of the four disk units 41-1 - 41-4. If an error is detected on one of the four disk units 41-1 - 41-4, that particular disk unit is disconnected and the controller 21 continues the read operation with the remaining three disk units. Masuyama does not disclose or suggest that the controller 21 can detect a disk unit of the four disk units 41-1 - 41-4 from which reading of either a data block or redundant data is no longer necessary and issue a read termination command to terminate reading of a current data block or redundant data by the detected disk unit of the four disk units 41-1 - 41-4, wherein the detected disk unit is enabled to commence reading of any subsequent data block or redundant data without being disconnected from the disk array device.

In response to the above assertion that the controller 21 does not function in the manner as the control part recited in claim 1, the Examiner refers to column 6, lines 20-34 and column 4, lines 35-50 of Masuyama and states that these sections disclose that upon detection of an occurrence of an abnormality or an error or an occurrence of timeout event on a disk, the detector/memory section 211 delivers faulty unit information to the disconnection managing section 212a which temporarily disconnects the faulty disk unit from the disk array apparatus such that the disk array operates in a temporary degenerated mode. The Examiner then states that these sections show that the faulty disk unit is temporarily disconnected and the disk array apparatus is operated in a temporary degenerated

mode and that it is apparent that is no longer necessary to read from the faulty disk since it is temporarily disconnected. However, it is unclear how the Examiner comments regarding these sections show how the controller 21 discloses the above discussed features of the control part of claim 1.

The Examiner contends that the faulty disk unit in Masuyama corresponds to the detected disk drive recited in claim 1. However, the faulty disk unit is detected when the detector/memory section 211 detects a fault, abnormality or occurrence of timeout event and not when the reading from the faulty disk unit is no longer necessary. Further, neither the detector/memory section 211 nor the controller 21 is disclosed as issuing a read termination command to the faulty disk unit. Instead, the failure of the faulty disk unit to properly respond (abnormality or error) or respond at all (timeout event) to a read command is what is used by the detector/memory section 211 to detect the faulty disk unit in the first place. In addition, the faulty disk unit is not enabled to commence reading of any subsequent data block or redundant data without being disconnected from the disk array device as is the case with the detected disk drive. Instead, the faulty disk unit is temporarily disconnected. This fact is even admitted in the Examiner's own remarks. As further evidence that the faulty disk unit is not enabled to commence reading of any subsequent data block or redundant data without being disconnected from the disk array device, column 5, lines 17-23 states that where a new writing instruction is supplied from a host computer during the temporary degenerate mode, the disk array apparatus writes new data and new redundant data into the remaining disks units with the fault disk unit temporarily disconnected. If the faulty disk unit was enabled as suggested by the rejection, the faulty disk unit would be able to receive and write data thereto. However, this is not the case.

In the combination, Chen is relied upon as disclosing the above discussed features of claim 1 which are not disclosed in Masuyama. However, Chen discloses a method and system that issue a long device busy signal of a finite duration for a storage device when an error or abnormality is detected on the storage device during which time resolution of the error or abnormality is attempted. The use of the long device busy signal is used to reduce the premature declaration of errors or abnormalities in the storage device. (See Abstract; and column 4, lines 8-35).

While Chen does disclose the use of a long device busy signal for a storage device as indicated in the rejection, Chen also discloses that the long device busy signal is used in conjunction with the

detection of errors and abnormalities which is similar to the disclosure of Masuyama. Further, the long device busy signal is indicated as isolating the storage device from any host inquiring about the storage device. Therefore, Chen also fails to disclose or suggest a control part operable to detect a disk drive from which reading of either the data block or the redundant data is no longer necessary, and issue a read termination command to terminate reading of a data block or redundant data by the detected disk drive. In addition, the fact that the long device busy signal isolates the storage device from all hosts, the storage device necessarily is not is enabled to commence reading of any subsequent data block or redundant data without being disconnected from the disk array device.

As a result, it is apparent that the combination of Masuyama and Chen fails to disclose or suggest the present invention as recited in claim 1.

Claim 5 is patentable over the combination of Masuyama and Yamamuro (US 5,841,748, since claim 5 recites a disk array device having, in part, a control part is operable to in response to a first read request sent thereto, refer to a faulty block table and determine whether or not (m-1) of m disk drives have previously failed to read each of the data blocks, when determining that the (m-1) disk drives have not previously failed to read each of the data blocks, issue second read requests to the (m-1) disk drives to read only each of the data blocks, and when determining that the (m-1) disk drives have previously failed to read each of the data blocks, issue second read requests to the m disk drives to read (m-1) of the data blocks and the redundant data. The combination of Masuyama and Yamamuro fails to disclose or suggest a control part as recited in claim 5.

As discussed above, Masuyama discloses a disk array apparatus having a disk array controller 21 that temporarily disconnects a disk unit of a plurality of disk units when an abnormality or error is detected in the disk unit during a read operation and continues the read operation with the remainder of the disk units. As indicated in the rejection, Masuyama fails to disclose or suggest that the disk array controller 21, in response to a first read request sent thereto, refers to a faulty block table and determines whether or not (m-1) of m disk drives have previously failed to read each of the data blocks, when it is determined that the (m-1) disk drives have not previously failed to read each of the data blocks, issues second read requests to the (m-1) disk drives to read only each of the data blocks, and when determining that the (m-1) disk drives have previously failed to read each of the data blocks, issue second read requests to the m disk drives to read (m-1) of the data blocks and the

redundant data. As a result, the rejection relies on Yamamuro as disclosing these features of claim 5.

Yamamuro discloses an optical disk 1 that has dummy data written thereon at the time of manufacturing. The dummy data is reproduced to determine whether a sector has a primary defect. If a sector does have a primary defect, physical address data of the sector is recorded in a primary defect list on the optical disk 1. When data is being recorded in units of ECC blocks on the optical disk 1, the sectors listed in the primary defect list are skipped. Further, once the data has been recorded in units of ECC blocks on the optical disk 1, the data is reproduced to determine if an ECC block has a sector with a secondary defect. If a sector does have a secondary defect, a replacement ECC block is written into a new sector, and physical address data of the sector with the secondary defect and physical address data of the first sector of the replacement ECC block are written into a secondary defect list which is referenced when the optical disk 1 is accessed. (See abstract; column 9, line 52 - column 10, line 5; and column 17, lines 17-68).

As discussed above, Yamamuro discloses that the optical disk 1 has primary and secondary lists which are referred to for purposes of determining the addresses of defective sectors of a single optical disk 1. The primary and secondary lists of Yamamuro are not disclosed or suggested as being referred to for determining whether (m-1) of m disk drives have previously failed to read each data block or not. Further, there is no disclosure or suggestion in Yamamuro that second read requests are issued to the (m-1) disk drives to read only each of the data blocks when determining that the (m-1) disk drives have not previously failed to read each of the data blocks and that second read requests are issued to the m disk drives to read (m-1) of the data blocks and the redundant data when determining that the (m-1) disk drives have previously failed to read each of the data blocks. This is supported by the disclosure of Yamamuro which explicitly states that "[t]he secondary defect list (SDL) 16 is a list for ECC blocks (defective blocks) having sectors which are determined to be defective at the recording time other than the above initial time. That is, it is a list of the physical sector numbers (physical addresses) of the first or head sectors of ECC blocks (defective blocks) having sectors which are determined as defective when data is recorded for preset ECC blocks and the physical sector numbers (physical addresses) of the first sectors of ECC blocks (replacement blocks: spare blocks) which are used for replacement for the defective blocks."

As a result, the combination of Masuyama and Yamamuro fails to disclose or suggest the present invention as recited in claim 5.

Because of the above mentioned distinctions, it is believed clear that claims 1-16, are allowable over the above-discussed references. Furthermore, it is submitted that the distinctions are such that a person having ordinary skill in the art at the time of invention would not have been motivated to make any combination of the references in such a manner as to result in, or otherwise render obvious, the present invention as recited in claims 1-16. Therefore, it is submitted that claims 1-16 are clearly allowable.

In view of the above remarks, it is submitted that the present application is in condition for allowance. The Examiner is invited to contact the undersigned by telephone if it is felt that there are issues remaining which must be resolved before allowance of the application.

Respectfully submitted,

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